DOCUMENT RESUME

ED 021 480 EM 006 338

By- Loehwing, David A.

THE CHALLENGE OF TECHNOLOGY A SYMPOSIUM ON EDUCATIONAL TECHNOLOGY. AN IDEA OCCASIONAL PAPER.

Kettering (Charles F.) Foundation, Dayton, Ohio. IDEA.

Note- 15p.

EDRS Price MF- $0.25 HC- $0.68

Descriptors- COMPUTER ASSISTED INSTRUCTION, COMPUTER ORIENTED PROGRAMS, *COMPUTERS, *CONFERENCE REPORTS, *EDUCATIONAL INNOVATION, ELECTRONIC DATA PROCESSING, GOVERNMENT ROLE, *INDIVIDUAL INSTRUCTION, INFORMATION PROCESSING, *INSTRUCTIONAL TECHNOLOGY, TEACHER ROLE

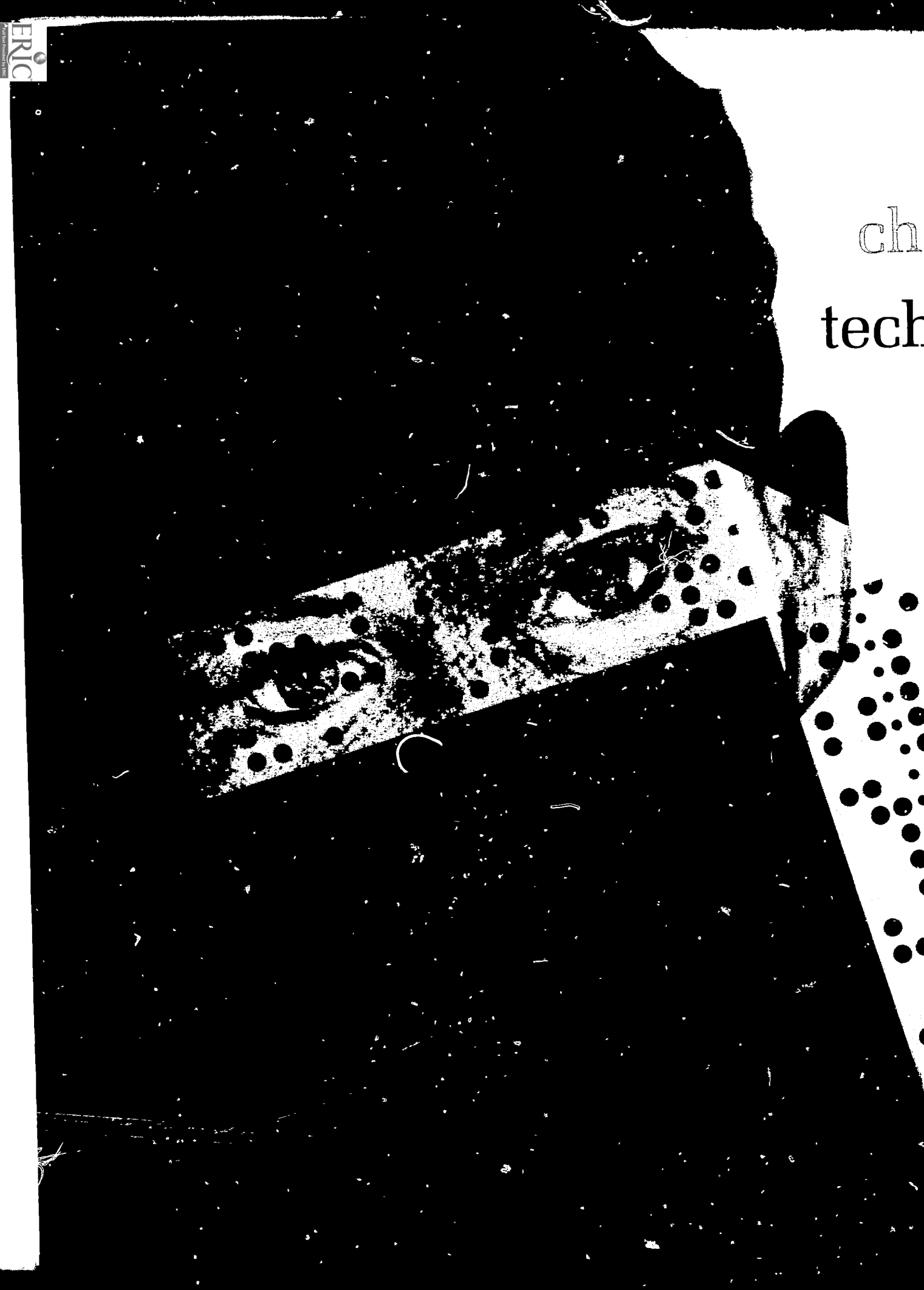
A symposium of industrial, governmental, and academic leaders was held to consider new technological devices and systems and to develop guidelines for teachers and school administrators on how to prepare for the coming age of technology in education. Topics under consideration included educational objectives, the historical and sociological background for the technological revolution in education, the need for the development and implementation of systems for general access to the collections of major libraries, and the potential applications in education of various scientific advancements, particularly in the realm of computers. Computers hold great promise as a means of individualizing instruction. But computer-assisted instruction is still in the experimental stage, and its widespread use in elementary and secondary schools remains some years away. Computerizing American schools will be an extremely expensive venture, with a large portion of the outlays going toward the purchase of machinery and the development of programs to be used. Complete re-education of teachers and school administrators will be necessary to enable them to cope with the evaluation and selection of computer-input material. The specific role of the teacher is yet to be defined. Much research needs to be done on the learning process, considering not only how to teach children, but what to teach them. (BB)

the challenge of technology

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
OFFICE OF EDUCATION

An |I|D|E|A| Occasional Paper

a
symposium
on
educational
technology



the challenge of technology

its impact on the schools

A score of top-ranking executives from industry, government, and the academic world gathered in New York City recently at the behest of I|D|E|A, the action-oriented division of the Charles F. Kettering Foundation. The intent of the seminar was to canvass the new technological devices and systems now being elaborated on in the press and news media and to develop guidelines for teachers and school administrators on how to prepare for the coming age of technology in education. The theme of the discussions centered on the rapid growth of technology, its impact upon the schools, and what needs to be done to help the schools prepare for this burgeoning development. Mr. Francis Keppel, former Assistant Secretary of Health, Education, and Welfare, now Board Chairman of General Learning Corporation presided over the seminar.

It was a free-wheeling session, with as many divergent viewpoints as participants. Few topics are capable of stimulating as lively a discussion these days as educational technology. All of the participants had something to say; and while there was a great deal of controversy, there was a considerable degree of acquiescense among the experts on the following:

1. If the new gadgetry being developed for schools has any utility, it is to help children break out of the "lock step" which has always plagued free, public education and learn as individuals, each at his own pace.

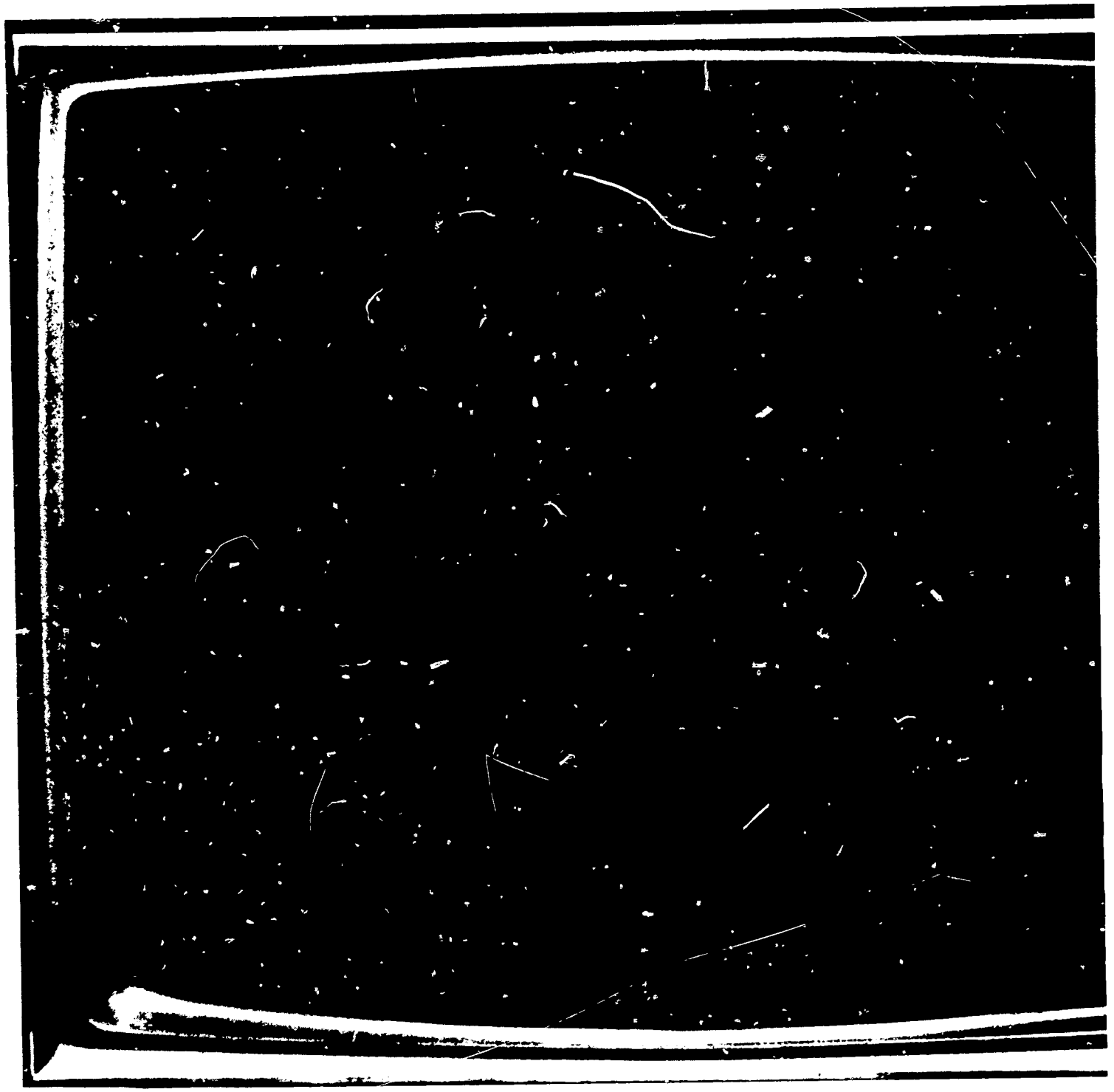
2. The most important new device with which schools will be called upon to deal is the computer. It holds great promise as a means of individualizing instruction.

3. Computer assisted instruction (CAI) is still in an experimental mode. It is likely to be some years before its use in elementary and secondary schools becomes widespread. Much time and money will be required to develop the necessary "software."

4. Computerizing American schools will be a fantastically expensive proposition, but somehow the money will be forthcoming — inevitably from the Federal Government. Equally inevitably, many educators will be concerned about possible control and censorship.

5. In the age of the computer, the role of the teacher remains to be defined. What seems inescapable, however, is that a complete re-education of teachers and school administrators will be necessary to enable them to cope with the evaluation and selection of computer input material.

6. Much research needs to be done on the learning process as a basis for decisions, not only on how to teach children, but what to teach them.



educational aims and objectives

Predictably, the conference devoted a good deal of discussion to educational aims and philosophies. "The objective of education is to prepare the individual for an unpredictable world," said the Rand Corporation's Mr. Goldstein. Hence, the impact of modern technology on the schools is not just a question of teaching methods; subject matter too must correspond to the technological demands of the world in which the student will live. Relating this concept to the computer, Mr. Goldstein pointed out: "The individual must get used to that animal if he is going to function in a modern society." Mr. Jovanovich of Harcourt, Brace and World said educators rightly have always been more concerned with subject matter than with learning processes, and much of the success of the new PSSC curricula type materials can be attributed to the fact that authors "sought to avoid teacher college emphasis on method." Nonetheless, he added, "the question of structuring is important."

Mr. Newton of Science Research Associates (an IBM subsidiary) sought to analyze the reasons for the failure of individualized instruction to take root. The concept has been around since the 1930's. "Why did it fail?" he demanded. "Will present attempts, as at the Oak Leaf School in Pittsburgh and elsewhere, fail too? In the world of business, if you have a good idea and pursue it, afterwards you can usually tell why it didn't succeed. Seemingly, though, it doesn't work that way in the education field." Unable to answer his own questions, Mr. Newton opined that, while the new technology will not assure the advent of individualized instruction, it should certainly facilitate matters.

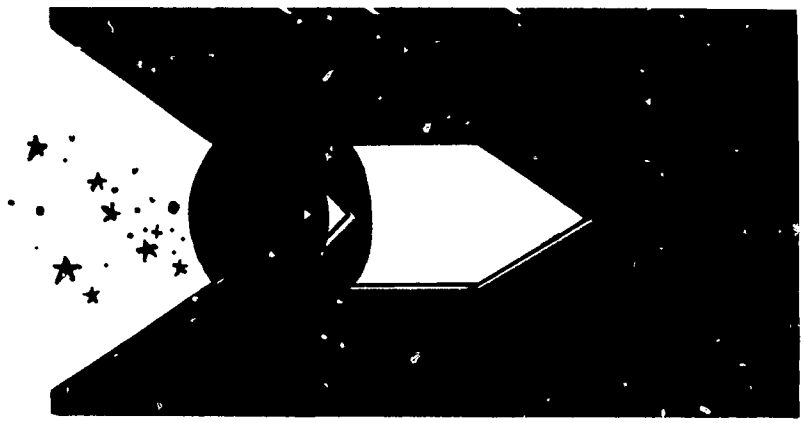
It was Father John Culkin of Fordham University's Communications Center who had the most to say about the philosophical underpinnings of the new technology. Applying the theories of the Toronto sage, Marshall McLuhan (Understanding Media, The Gutenberg Bible, The Mechanical Bride) to education, Father Culkin comes to the conclusion that today's schools should provide a "total electronic environment" and teach students to be "their own data processors" if education is to be effective in an ecology where children absorb 3,000-4,000 hours of television before starting the first grade.

The new communications media — radio, movies, telephones, and hi-fi, as well as TV — are altering the psychological intake systems to today's children, in McLuhan's view. "It is setting up new ratios among the senses," adds Father Culkin, who goes on, "The learner these days comes to school with a vast reservoir of vicarious experiences and loosely related facts; he is accustomed to communication through image and sound; he wants to be involved in what he is doing; he knows incohatively that he lives in a global village, in a spaceless age; he wants to use all his senses in his learning as an active agent in the process of discovery; he knows all the answers aren't in. The new learner is the result of the new media . . . and a new learner calls for a new kind of learning.

"The electronic media have broken the monopoly of print; they have altered our sensory profiles by heightening our awareness of aural, tactile and kinetic values . . . The new learner, who is the product of this all-at-once electronic environment, often feels out of it in a linear, one-thing-at-a-time school environment . . . Interestingly, the one thing which most of the current educational innovations share is their break with linear or print-oriented patterns: team teaching, nongraded schools, audio-lingual language training, multi-media learning situations, seminars student research at all levels of education, individualized learning, and the whole shift of responsibility for learning from the teacher to the student."

Dr. Elliott of the Illinois Institute of Technology expounded eloquently on what expanding technology should mean to students. Obviously, they will need to acquire new skills in order to manipulate the machines, but Dr. Elliott thinks there are deeper implications:

"Students should be made to realize at an early age that expanding knowledge is at the foot of expanding technology. For the productive individual at all levels, this implies continuing education throughout one's lifetime. Thus, rapidly growing technology affords an opportunity to stress the true meaning of education. Education is not training. It is not reaching a level that is never transcended. Education is the equipping of the individual with the tools, the capability, and the desire to continue his personal and professional development as long as he lives. It is an attitude of mind; not a terminal degree. And it may be that the major contributions made by the discovery of new science and its application to technology will trigger even greater contributions to society by forcing us to discover ways to motivate and nurture the quality of mind that continually renews itself through the pursuit of knowledge."



setting for a revolution

There was considerable discussion about the historical and sociological background of the technological revolution in education. Here is the gist of what 3M Company's Mr. Gavin had to say on that subject:

"This is a NOW period for American education. It started about ten years ago with the launching of a space vehicle half-way around the world, but the real strides are just beginning to be made; the real impact is just beginning to be felt."

"What might be called Sputnikology actually started this painful reappraisal nearly ten years ago. In our desire and haste to produce more trained people we have not always produced better trained people, but some lessons have been learned. One of them is that industry knows something about the communications procedure — nose to nose relationships, if you will — and another is that education can benefit from industrial experience."

"Largely in the hands of education is the steadily increasing need to preserve individualism and opportunity for the individual as we become more and more alike. In a mass society we pose threats to democratic institutions and to the individual. Industry's obligation to the free enterprise system, from whence it comes, is to create opportunities for individuals."

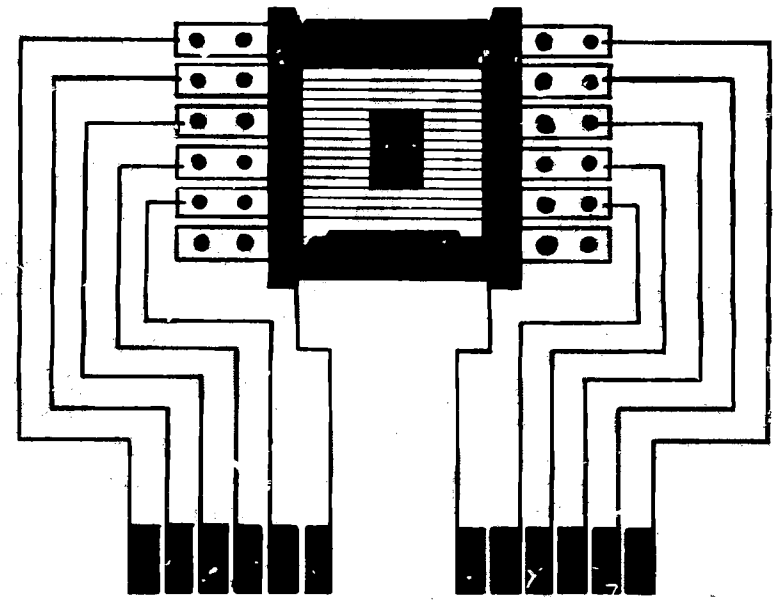
On a more mundane plane, conferees were concerned that tomorrow's "systems for learning" find greater acceptance and utilization than the gadgetry now on the market. "Introduced in the late 1950's, programmed instruction had been oversold by the early 60's," Mr. Goldstein pointed out. "How many pieces of language laboratory equipment are lying around in school basements, unused because teachers had no language tapes and wouldn't have known how to use them anyway?" It was generally agreed that companies in the learning industry have been remiss in selling hardware to the schools without being able to make adequate and functional software available. Also, they have needlessly incurred the hostility of educators with talk of "teaching machines" which would replace teachers or reduce them to the role of classroom guardians.

Participants in the symposium showed little tendency to dwell on the industry's past mistakes. Nor, for that matter, did the conferees pay much attention to present-day technology — film and slide projectors, tape recorders, autotutors, talking typewriters or closed-circuit television. The emphasis was entirely on developments which are known, but have yet to reach the market.

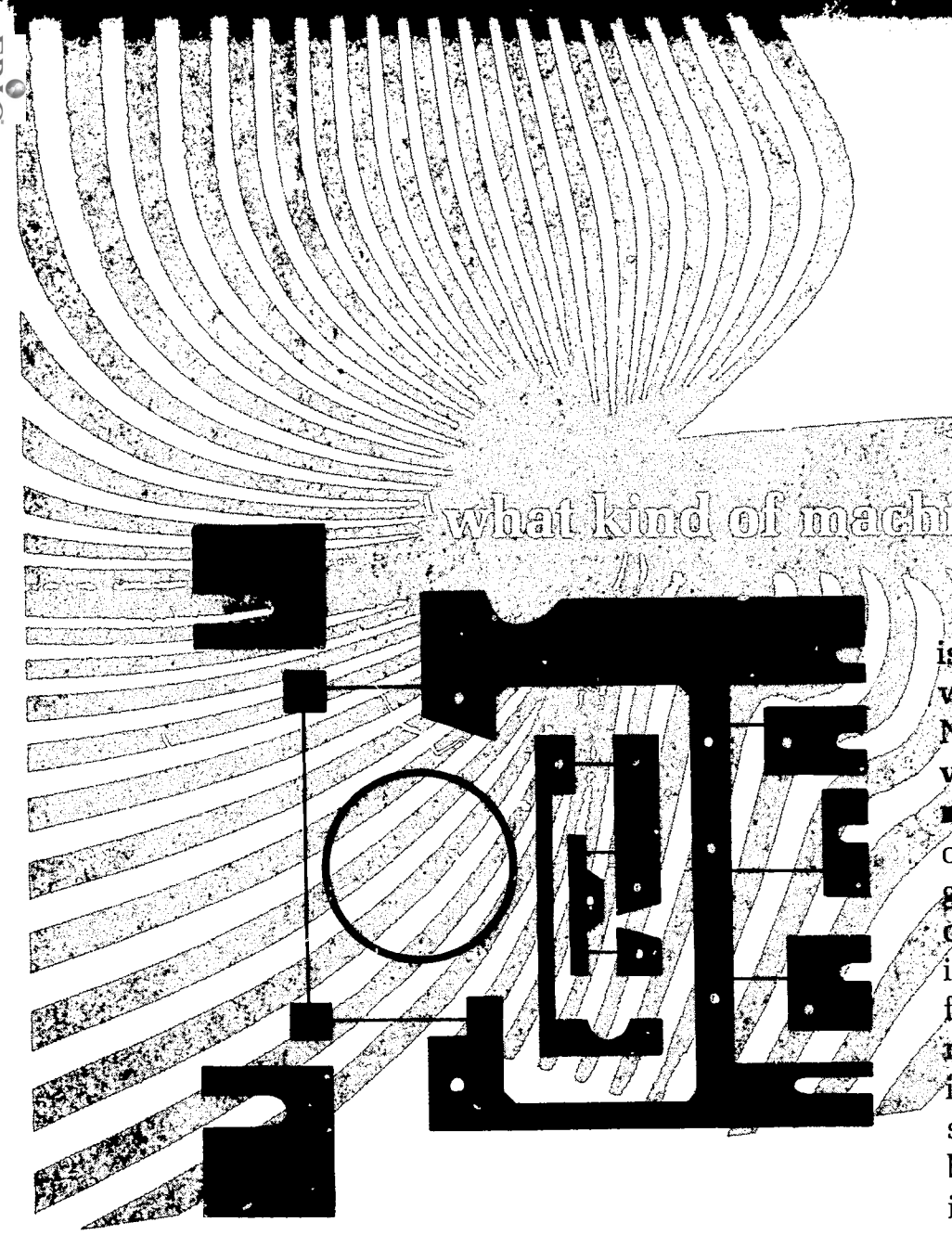
"There is an assumption that modern technology is a good thing," Chairman Keppel told them. "The issue before us is what can be done to help the schools prepare for the exciting development of technology and what will be their impact on the schools.

the storage and retrieval dilemma

One of the urgent tasks of technology is to provide general access to the collections of great libraries. As to how this will be accomplished, the symposium participants agreed that, for the purpose of discussion, the best type of technology was insignificant. They did agree that technological engineers planning for this development have a choice of three alternatives:



(1) storing and retrieving information on sophisticated new microscopic transparencies, (2) the use of solid state devices for both storage and retrieval, (3) the propelling of conventional books hither and yon thru a national network of pneumatic tubes.



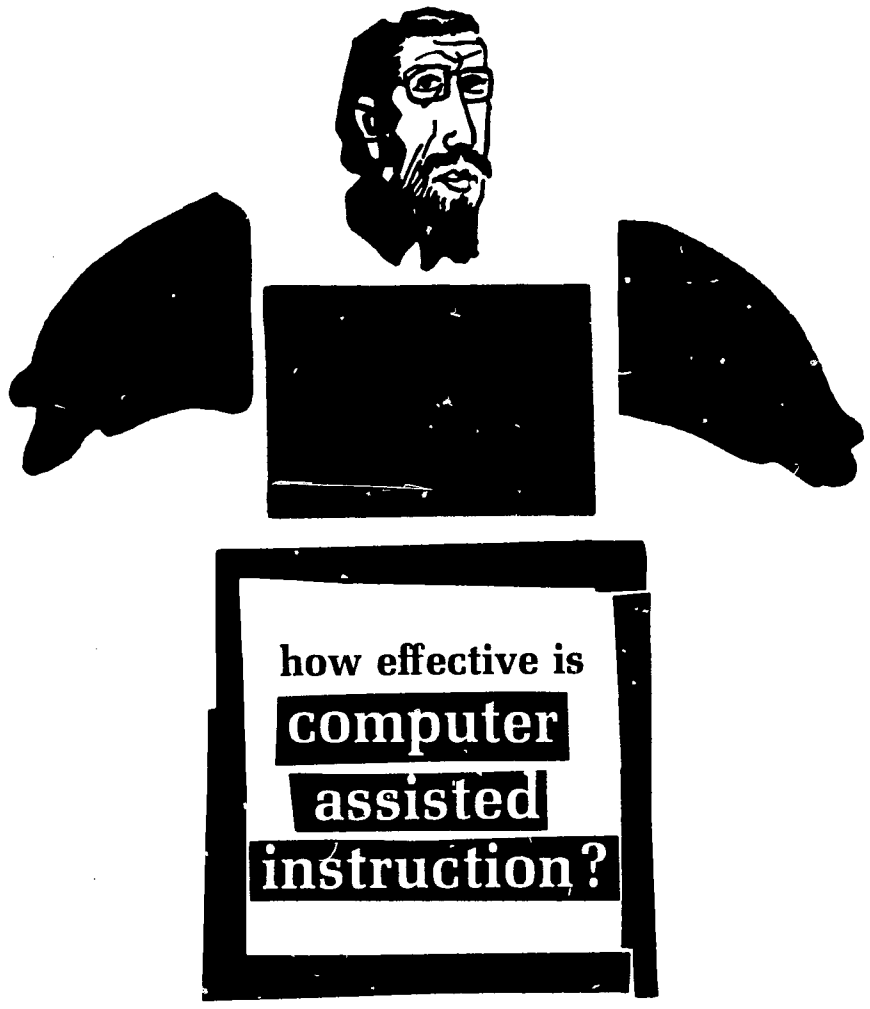
Mr. Muller of IBM emphasized that "there is not just one, but a number of technologies which must be orchestrated," and SRA's Mr. Newton enumerated them as follows: **1. The video tape recorder; 2. Micro-image equipment; 3. The computer.** The first, he said, is on the verge of a major breakthrough in regard to cost; inexpensive recorders with color capability soon will be on the market, providing educational television with a degree of flexibility and means of distribution which motion picture films never achieved. Micro-image technology, by contrast, still is out of sight for schools from a standpoint of cost, but Mr. Newton noted that it is still in its infancy, and he expressed the opinion that eventually a breakthrough will be made. Its significance is to be found, he said, in the fact that the mathematics program used in an individualized setting is alleged to require 500,000 sheets of paper. "There's got to be a better way," Mr. Newton declared.

As for electronic data processing (EDP) systems, Mr. Muller pointed to five different "modes" wherein computers can serve educators. They are: **1. Record-keeping** — all the dreary chores of the school's central office, from cost accounting to recording children's grades, can be reduced to a machine function. **2. Student testing and evaluation.** Here, much more sophisticated techniques can be developed. For example, the computer can measure the amount of time it takes a pupil to respond to each question, rather than simply giving him a "right" or "wrong"; then, by recording his responses to myriad questions over an extended period of time, it can compile an accurate personality and aptitude portrait which can be used to ascertain and direct his talents. **3. Information retrieval.** Such are the dimensions of the "knowledge explosion" that only through EDP techniques can libraries hope to make the information they contain readily available to students. **4. Programmed instruction.** Computers can make this technique far more effective than any other type of so-called "teaching machines". **5. Problem solving and simulation.** Working with the computer, a student can set up the conditions of any problem — say, for example, the operation of a department store for a year, or an astronaut flight to the moon — and then work out his own solutions. This process of simulation or gaming, some psychologists say, is the optimum mode for learning.

Educators should be aware of three developments in electronic data processing which are of importance in adapting the computer to school use. Probably the most far-reaching of these is time-sharing, which enables a number of persons to communicate with a computer at the same time from different terminals. The implications of time-sharing for the schools is obvious: one machine with multiple input-output devices might well suffice for an entire school system.

Secondly, companies involved in electronic data processing have developed computer "language" systems which make it possible for teachers and students to communicate with the machine in their own natural English without learning complicated programming techniques.

Finally, IBM and other computer companies have brought out instructional systems which will enable educators, utilizing both of the foregoing, to place the student in a situation very much like the 'total electronic environment" urged by Father Culkin. For example, the IBM 1500, now being extensively tested at the Brentwood Elementary School in East Palo Alto, California, enables the child to communicate with and receive instruction from the machine in several different ways. Initially, there is the high-speed typewriter for both instruction and response. In addition, the machine can "talk" to the student by means of tape-recorded messages which it has been programmed to select in accordance with his responses. Thus, if he types out **"blue"** in response to a question calling for the answer **"red,"** the computer instantly selects a tape which might say, **"Pay attention, now, you know very well the blue cars all have been eliminated. Try again."** For visual communication, there is a cathode ray tube display which is much the same as a home television screen. In addition, the computer may show slides, which it selects from a random access slide projector, in accordance with the student's responses. The student can respond by means of a light pen with which he touches the surface of the cathode ray tube.



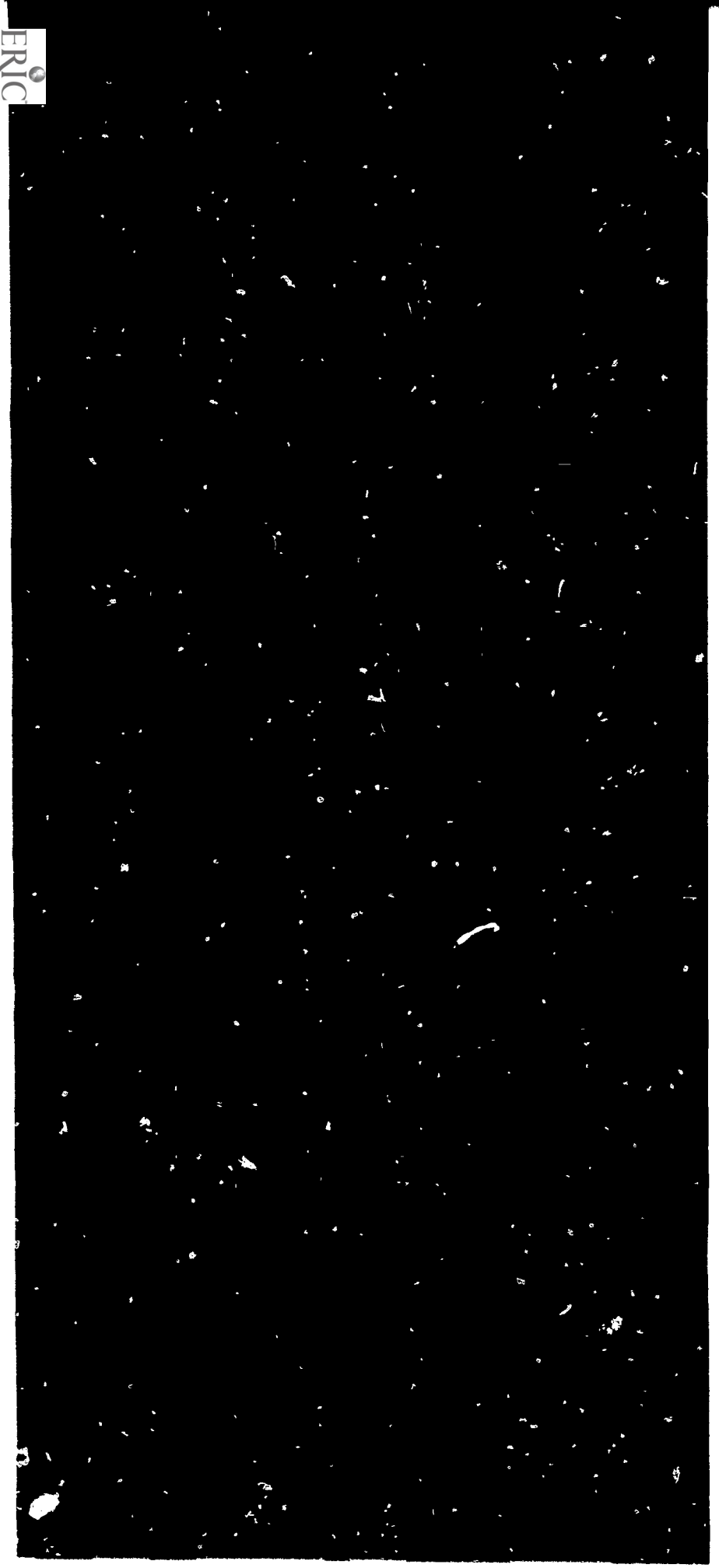
This system permits the most effective use of programmed instruction, with virtually unlimited branching capability. How efficient it is in an actual teaching situation, however, remains to be determined. No evaluation has yet been made of the highly touted Palo Alto experiment, and IBM officials wish to avoid making premature claims. IBM's Muller told the conference:

"The computer, as you know, has clearly proved to be effective in science, government, and business. The results have been measurable in quantity and quality. However, education presents us with an entirely different environment. Efforts to use this device as an integral part of instruction in the classroom are, at best, exploratory. It would be misleading to suggest that the computer and related technology offer some kind of panacea for the pressing problems in education. After all, technology is a means, not an end. We should, therefore, be wary of claims and, indeed, speak out clearly to the effect that we do not yet know the implications of technology for education."

Having laid down all those caveats, Mr. Muller conceded that IBM nonetheless sees its computers as having a very pervasive role in education. He added: "We want the computer to do more than just improve the educational process. We visualize a situation where the computer actually becomes an extension of man's mind. If man, with his creativity, could freely communicate with the computer, profound changes might take place in our civilization. By exposing the child to it from the start, so that he turns to it naturally for the solutions to his problems, we may reach that stage."

If all the schools in the country could be equipped with IBM 1500 systems tomorrow, computer advocates admit, the nation's children would benefit little. Instructional materials would still have to be programmed into them. Just as in business offices and scientific laboratories, the computer's effectiveness as an educational tool will depend largely on the quality of the "software" fed into it. Symposium participants were unanimous on the point that educational data processing avoid what EDP experts have dubbed the GIGO system of programming: garbage in, garbage out.

Mr. Silberman described in some detail the experience of System Development Corporation in trying to develop better instructional materials:



"We conducted a fairly extensive series of experimental comparisons. The most notable result of these comparisons was that only marginally statistical differences among experimental treatments were obtained. Different sequencing procedures, cuing techniques, and confirmation procedures had but limited practical effect on student learning.

"But one procedure we tried did succeed. This consisted of a careful specification of learning objectives in behavioral form, followed by a succession of evaluation-revision cycles. As each defect in the instructional material was detected, the behavioral components involved were re-analyzed and specific changes made to the defective segment. Ideas for possible changes were obtained from interviews and individual tutorial sessions with students. Gaps were filled, irrelevancies eliminated, and frames were modified. Repeated evaluation revision cycles were conducted until new students exposed to the materials consistently achieved a given set of absolute objectives.

"This process is like the cut and-fit engineering process where the development activity is followed all the way through the final stage of implementation. It is an extremely costly process, since building a product to specifications can be an endless task. Rather than merely making a single evaluation to decide whether to adopt a new set of material, the engineering approach implies a commitment to make the new material work, since most things fail on the first try anyway. Persistent use of the evaluation-revision cycle will eventually produce quality materials that do work."

Dr. Edward E. David, Jr. of Bell Telephone Laboratories emphasized that the significance of computers is much broader than the mere individualizing of instruction. According to David:

"Computers provide a means for the student to reach an unusual depth and clarity of understanding. In working with a computer, the student must phrase his thoughts in clear, unequivocal, logical language which can then be objectively evaluated against the rigors of machine testing. This technique has proven to be quite effective in, for example, the teaching of computer programming itself. A course of this kind has been written and used extensively at the Bell Telephone Laboratories.

"Computers provide the opportunity of freeing the understanding of concepts and their application from the traditional dependence on algebraic dexterity. They permit the student to deal with "operating" models of real-life situations directly. For example, the computer can create artificial environments from which students gain insight and intuition through experience. Specifically, Professor W. H. Huggins at Johns Hopkins University has created a program known as JOBSHOP. Students can design and construct simulated electrical circuits with many of the fluctuations and unavoidable uncertainties which one finds in a real circuit job shop. The Science Teaching Center at MIT has developed a program through which students can see, via a graphic console, the appearance of the landscape as "they drive through it" at speeds approaching that of light. Here students gain intuition through an experience unobtainable in any other way.

the high cost of software

"The importance of software as opposed to hardware was emphasized in the Symposium summary. However, the corollary to the point, which is not included, is that schools should favor access to software which has been created and maintained by others. In gaining this access, communication facilities will be vital. These may include lines especially set up for the purpose or commercially standard services such as dial telephone, TWX, or TELEX. The coupling of software and communications could be a major step in relieving the isolation that teachers feel, particularly in the smaller schools. Adequate communications can give any teacher access to resource materials today available only to the largest schools."

Turning out programs by such methods can run up the cost of computer assisted instruction tremendously. Dr. Bright brought the question of costs into perspective by recalling a conversation with a large-city superintendent of schools who suddenly found himself in possession of a big sum of Title I money to spend. The superintendent asked Dr. Bright's advice on whether he should launch a computer assisted instruction project. "I told him," Dr. Bright said, "that the $1,200,000 he would spend for the computer would be only the start. He should go into it only if he was prepared to put up another $700,000 for software."

managing the system

Many other difficulties besides cost were foreseen by the panel. Mr. Silberman, for one, fears the schools will be faced with a critical management problem when they embark on

CAI: "If students move through the instruction at their own rate, how will it be possible to keep track of them? How is it possible to detect those who are not performing correctly and to diagnose the source of the trouble? One of the greatest deterrents to individualized programs is the difficulty of managing the instruction—far easier when everyone is kept in lockstep groups, even at the expense of optimal learning. The resistance to individualized instruction may not stem from conservatism as much as from the management problems associated with it."

Mr. Jovanovich of Harcourt, Brace, and World pointed out that the new technology would tend to alter the centuries-old "concordat" between teachers and textbook publishers. School curricula traditionally have resulted from that relationship, wherein the publisher employs individual teachers to write books which he then seeks to sell to a large number of schools by obtaining teacher approval of them. In that context, Mr. Jovanovich said, "The selection of one textbook over another wasn't a big thing."

With the advent of modern technology, however the old formula is no longer valid. Mr. Jovanovich said: "You're now talking about multi-media systems of great cost and complexity, and the individual teacher is not competent to make judgments about them. Fears arise that IBM or Litton Industries is going to rape the school system. The Federal Government immediately becomes alarmed and steps in, and then the question of censorship becomes involved. What the motives of the Federal government are, to say the least, is obscure."

what is the teacher's role?

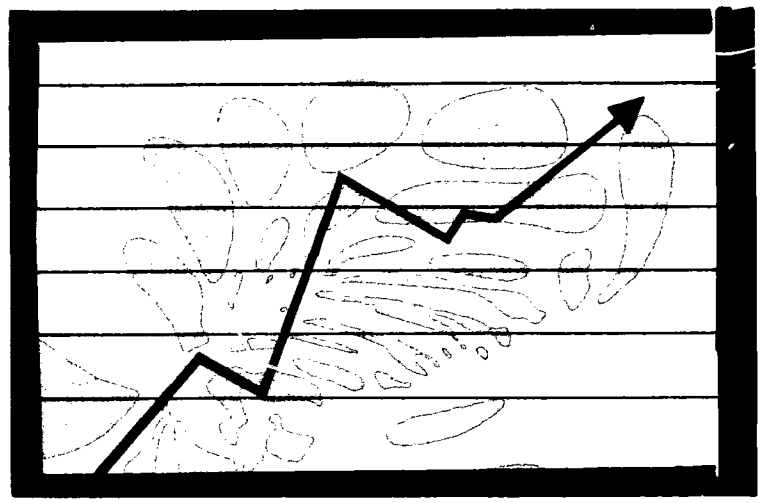
Still another difficulty to be overcome in introducing the computer into the schools is its lack of human warmth. The 3M Company's Mr. Gavin stated the matter succinctly: "It never gets mad at a kid and never swats him with a ruler — but it never pats him on the head or puts its arm around his shoulder, either." Mr. Gavin expressed the fear that by leading educators into the "sociological jungle of man-machine relationships" the computer might create more problems that it will solve.

Moreover, the machine might be as disturbing to teachers as to students. Dr. Bright cited the case of a physics instructor in a high school who became fascinated with the possibilities of the new PSSC curricula — not just the courses themselves, but the teaching manuals, which he thought might give students even greater insight into the subject. He went so far as to order a teaching manual for each of his students? What happened? The students took over the teaching of the class and learned far more about physics than they would have learned in their normal, passive role as students. The teacher, however, soon felt frustrated and unneeded. "The basic reason that programmed instruction and other modern techniques haven't gained greater acceptance in the schools," said Dr. Bright, "is that there is no comfortable role for the teacher."

Dr. Bright went on to cite the experience of a writer of programmed instruction material who discovered that his programs were really effective only in classes with elderly teachers who were within a few years of retirement. 'Younger instructors are too involved with teaching methods and with the subject matter," Dr. Bright declared. "Some of the older ones are able to make better use of the new technology because over the years they have become interested in kids." Most of the men participating in the conference agreed that, before modern technology can help the nation's school children, a massive re-education of teachers will be necessary.

Still, the biggest stumbling block to the use of computers in the schools, conferees agreed, is financing — where the money is coming from. On this point, a recent survey by the Morgan Guaranty Trust Company is enlightening and encouraging. Adopting a hard-headed banker's approach to the economic factors involved in the educational posture of the U. S., the Survey notes that some 30% of the nation's youths do not finish high school, and "this results in the entry into the labor force each year of several hundred thousand young people who lack the basic knowledge, let alone the formal certification of knowledge, which employers require for most jobs. Moreover, with considerable spottiness in the quality of education among different localities, even a good many high school graduates are ill-prepared for either today's jobs or for constructive roles as citizens."

The cost of public education in the U. S. since World War II has been rising at an annual rate of 12½%, far out of proportion to gains in national income. In fact, from the equivalent of 2% at the end of the war, the proportion of gross national product spent for education has risen to between 6½% and 7% now. Surprisingly, though, the Morgan Guaranty regards today's outlays of $50 million annually as insufficient.



schools: an economic resource

"Besides all the traditional considerations that argue for a better educated citizenry, it is coming to be increasingly appreciated that substantial economic benefits accrue to society at large as the work force grows more knowledgeable," says the Survey. "More and more, in fact, economists are coming to look at education as a kind of capital formation, yielding income increments to individuals and society in much the same way as does investment in non-human capital."

Backing up this theory, the Survey cites research by Dr. Edward F. Denison of the Brookings Institute which shows that from 1929 to 1957 the advance of knowledge resulting from increases in the level of formal education of the U. S. population accounted for 23% of the growth rate of the national product. "While other investigators have produced different estimates (some higher, some lower), there is general agreement among economists that educational improvement has been a major source of national economic growth," says the Survey.

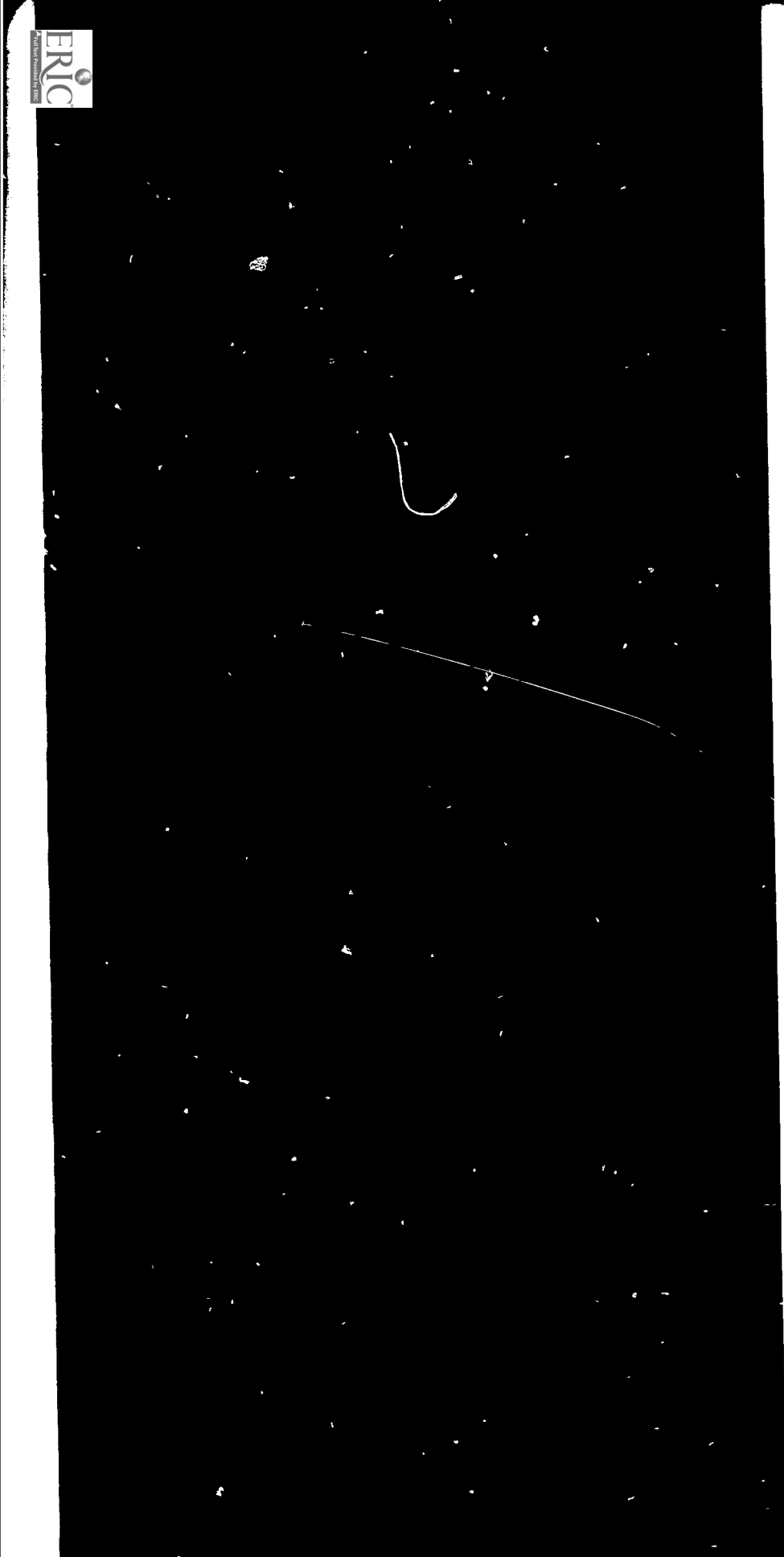
It continues: "The general conclusion reached by virtually all investigators who have sought to measure lifetime rates of return associated with varying levels of educational attainment is that the United States still has a long way to go before the costs of additional education offset incremental benefits. Stated differently, the U. S. is judged to be underinvesting in human capital in the sense that a further increase in both high school and college attendance and a further improvement in the quality of education at all levels would be economically profitable."

Going on to examine the possibility of "truly individualized instruction by means of computers," the Survey says: "Electronic instruction, various experiments suggest, holds exciting possibilities for shortening the time students spend on learning those subjects that are amenable to programming — cutting learning time by perhaps as much as three-fourths." It should be noted here that no one at the symposium made any estimate of the degree of learning efficiency which might be achieved with Computer Assisted Instruction. To the contrary, Mr. Muller of IBM made every effort to discourage speculation on that point, insisting that there has been no scientific evaluation of CAI and that to prematurely publicize figures not based on sound observation would be misleading and a disservice to educators. Nonetheless, the Morgan Guaranty Survey quotes Dr. Norman Kurland, Director of the Center on Innovation in Education of the New York State Education Department as saying that the computer will be "almost a universal tool of education within ten years."

another resource: federal funds

Where the money will come from worries the ebullient bankers very little. To be sure, the Survey concedes, states and local school districts are pretty well tapped out. "Spending by such bodies on education has quadrupled in the past 15 years, significantly outpacing the rate of increase in total budgetary revenues. This has imposed restraints on state and local outlays for other purposes and also has necessitated heavy recourse to borrowing. With pressures mounting for more emphasis on such things as health programs and pollution control programs, and with reduced leeway for additional borrowing, states and localities face serious impediments to a continued rapid increase in spending on schools."

Washington is coming to the rescue. Total Federal spending on education, which rose from $1.5 billion in 1955 to $5.5 billion in 1965, is expected to reach $9 billion next year, according to the Survey, and it forecasts higher levels in coming years. Moreover, the population of school-age children no longer is growing at such an alarming rate, and the school



construction backlog has been substantially reduced by the hectic building pace of recent years; hence, more of the money being made available by the Federal government can be devoted to capital equipment, rather than bricks and mortar.

At the symposium, Mr. Silberman pointed out that schools need not necessarily adopt an all-or-nothing approach to computerization, with a console for every student and the basement full of whirring robots. It would be far better, he says, to start with a single typewriter terminal tied into someone else's time-shared computer system. This can be used for routine data processing — the payroll, attendance reports, helping the school administrator with his budget.

A full-blown computer system then can gradually be acquired on the modular, or building-block, principle — what Mr. Silberman calls "an evolutionary approach to system development." This has significant advantages beyond the fact that it doesn't concentrate the entire cost of the system in a single budgetary period. One is that it gives members of the staff a chance to familiarize themselves with computer technology gradually; rather than resisting the invasion of their realm by "the machine," teachers soon will be queuing up for a turn at the keyboard as they begin to collect data on student performance and to develop their own instructional material. Equally important, the initial cost can be justified more readily as a management tool than as an instructional device.

"Another method of reducing the cost . . . is to degrade the system to some less costly configuration," says Mr. Silberman. "For instance, instead of providing an input terminal for each student, a smaller number of terminals can be shared among students who are scheduled (by the computer) to use the terminal at different times of the day. Another approach is to use a simple button box input with small feedback lights instead of the more elaborate 'rich' terminal with its TV tube, keyboard, random access film and sound, etc."

The symposium panel strove vigorously to agree on some advice to teachers and school administrators on how to judge and evaluate not only the computers and other instructional devices with which industry is preparing to equip the schools, but also the programs, or "software," which must be made available before the machines will be at all useful as instructional tools. In opting for one system or another, the administrator will commit his school district to vast outlays for both hardware and software, although in most cases he is not qualified to judge whether the system is a viable one. It was suggested that the government would have to step in and make unbiased evaluation studies, but the objection was immediately raised that this could lead to too much Federal control over the educational establishment.

"We are beginning to feel that we can at last make individualized instruction practicable. We are on the threshold of a technological revolution in education, that is what the breakthrough in technology is all about." Dr. R. Louis Bright, Associate Commissioner for Research at the United States Office of Education, summarized in those words the message which industry wishes to communicate to the nation's schools.

participants

Mr. Frank Keppel, Chairman

Mr. Donald F. Beilman
Manager
Electronic Systems Laboratory
General Electric Company

Dr. R. Louis Bright
Associate Commissioner for Research
U. S. Office of Education

Mr. M. P. Chintz
Associate Director
Systems Designs and Applications
UNIVAC

Mr. Samuel Convissor
Administrator, Community Relations
RCA

Reverend John Culkin
Director
Communications Center
Fordham University

Dr. Edward E. David, Jr.
Executive Director
Communication Systems Division
Bell Telephone Laboratory

Dr. Martin A. Elliott
Vice President for Academic Affairs
Illinois Institute of Technology

Mr. Roy J. Gavin
Division Vice President
Revere-Mincom Division
Minnesota Mining and Mfg. Co.

Dr. Albert Goldberg
Industrial Manager for Government and Education
Honeywell, Incorporated

Mr. Richard Goldstein
Vice President
The Rand Corporation

Dr. William H. Guier
Applied Physics Laboratory
The Johns Hopkins University

Mr. Louis Hausman
Special Assistant to
The U. S. Commissioner of Education

Mr. William Jovanovich
President
Harcourt, Brace and World, Inc.

Dr. Edward L. Katzenbach
Vice President and General Manager
Education Division
Raytheon Company

Mr. Herman Keld
Sales Coordinator
MGM-TV

Mr. Frank Keppel
Chairman of the Board of Directors
General Learning Corporation

Mr. L. A. Muller
Director of Instructional
Systems Development
IBM

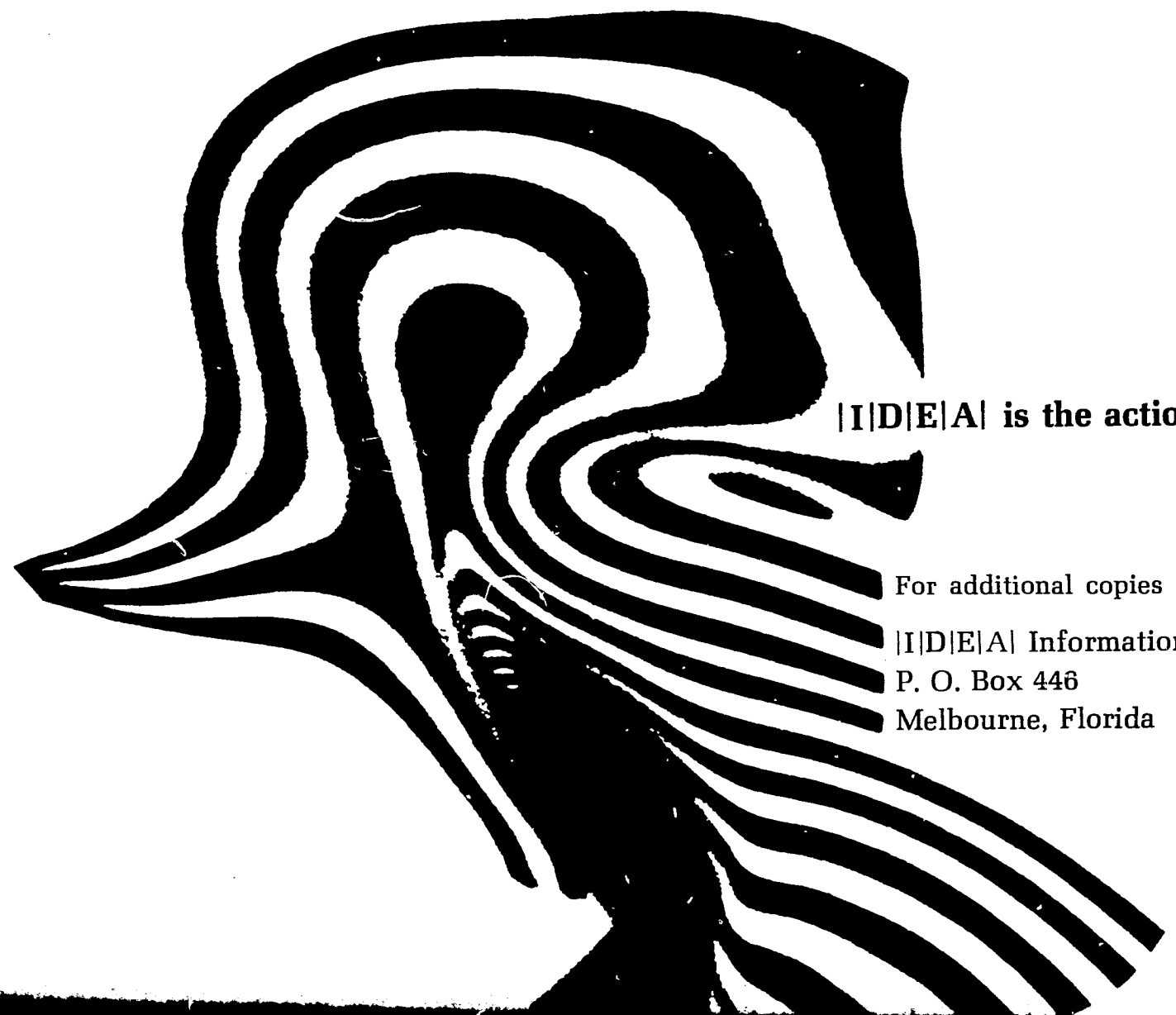
Mr. D. V. Newton
Director
Advanced Product Development
Science Research Associates, Inc.

Mr. P. E. Schruth
Vice President
Westinghouse Broadcasting Company

Dr. Harry F. Silberman
Head of Education and Training
Research and Technology Division
System Development Corporation

Mr. James H. Straubel
Executive Director
Aerospace Education Foundation

Mr. David A. Loehwing (conference reporter)
Associate Editor
BARRON'S
Dow Jones & Company, Inc.
Publishers



|I|D|E|A| is the action-oriented Division of the Charles F. Kettering Foundation

Winters Bank Building, Dayton, Ohio

For additional copies of this pamphlet, write to.

|I|D|E|A| Information Office
P. O. Box 446
Melbourne, Florida